Total No. of Questions : 10]

SEAT No. :

P3152

[Total No. of Pages : 3

[4858]-1017

T.E. (semester - II) (Mechanical) (End Semester)

TURBO MACHINES

(2012 Pattern)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2 , Q.3 or Q.4 Q.5 or Q.6, Q.7 or Q. 8 , Q.9 or Q. 10.***
2) ***Figures to the right indicate full marks.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume data wherever necessary and mention it.***
5) ***Draw neat and suitable figures wherever necessary.***

Q1) a) Derive an expression of maximum hydraulic efficiency of Pelton Wheel? **[6]**

b) Explain the following terms: **[4]**

i) Specific speed

ii) Run - away speed.

OR

Q2) a) The inner and outer diameters of the wheel are 1.5 m and 2 m respectively. Water flows outwards over the series of moving vanes attached to the wheel . The wheel runs at 250 rpm. Water is discharged radially at the exit with a velocity of 5 m/s. Work done per kg of water is 250 N-m. The velocity of flow through the runner is constant.

Determine: **[6]**

i) The angles of the moving vane tips

ii) Guide vane angle at inlet

b) Compare Francis Turbine and Kaplan Turbine. **[4]**

Q3) a) Explain the classification of water turbines with examples? **[4]**

b) Derive an expression for maximum utilization factor (Diagram efficiency) of Parson's reaction turbine in terms nozzle angle? **[6]**

P.T.O.

OR

Q4) a) Derive an expression of Unit Quantities. **[6]**

b) Explain with neat sketch throttle governing of steam turbines? **[4]**

Q5) a) Explain the Priming and Cavitations of Centrifugal pump? **[8]**

b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm work against total head of 40 m. The velocity of flow through the runner is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 50 cm and width at outlet is 5 cm, Determine —

i) Vane angle at inlet

ii) Workdone by impeller on water per second

iii) Manometric efficiency **[10]**

OR

Q6) a) Derive an expression of minimum starting speed of centrifugal pump? **[8]**

b) A centrifugal pump running at 900 rpm is working against a head 20 m. The external diameter of the impeller is 460 mm and outlet width is 50 mm. If the vanes angles at outlet is 40° and manometric efficiency is 70 % determine.

i) Flow velocity at outlet

ii) Absolute velocity of water leaving the vane

iii) Angle made by the absolute at outlet with the direction of motion at outlet

iv) Rate of flow through the pump **[10]**

Q7) a) Explain the terms Surging and Choking in a rotary compressor. **[8]**

b) Represent and explain the process involved in centrifugal compressor on (T-S) diagram and derive the expression for isentropic efficiency based on total values. **[8]**

OR

Q8) a) Explain Slip coefficient and Pressure coefficient. **[4]**

b) A centrifugal compressor running at 9000 rpm delivers 600 m^3/min of free air. The air is compressed from 1 bar and 20° C to a pressure ratio of 4 with an isentropic efficiency of 82 %. Blades are radial at outlet of impeller and flow velocity of 62 m/s may be assumed throughout constant. The outer radius of impeller is twice the inner and slip factor may be assumed as 0.9. The blade area coefficient of 0.9 may be assumed at inlet.

Calculate -

i) Final temperature of air

ii) Theoretical power

iii) Impeller diameters at inlet and outlet

iv) Impeller blade angle at inlet

v) Diffuser blade angle at inlet

vi) Breadths of impeller at inlet **[12]**

Q9) a) Explain the construction and working of an axial flow compressor. **[6]**

b) An axial flow compressor is required to deliver air at the rate of 50 kg/s and provide a total pressure ratio of 5 :1 , the inlet stagnation conditions being 288 K and 1 bar. The isentropic efficiency is 86 %. The compressor shall have 10 stages with equal rise in total temperature in each stage. The axial velocity of flow is 150 m/s and the blade speed is kept at 200 m/s to minimize noise generation . The stage degree of reaction at mean blade height is 50 %. Assuming workdone factor as 0.86, calculate all the fluid angles of the first stage. Also calculate the tip and hub diameter if hub-tip diameter ratio is 0.8. Determine the speed in rpm. (R = 287 J/kg K, Cp = 1.005 kJ/kg K). **[10]**

OR

Q10)a) Explain the following terms -

i) Stalling in an axial flow compressor

ii) Losses in axial flow compressor **[8]**

b) Represent and explain the process involved in axial flow compressor on (h-s) diagram and derive an expression for isentropic efficiency and stage pressure ratio. **[8]**